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Mississippi State University
School of Forest Resources

E85-10022

Remote Sensing Applications Program

(E85-10022 NASA-CR-174045) REMOTE SENSING
APPLICATIONS PROGRAM Summary Report, Nov.
1973 - Oct. 1984 (Mississippi State Univ.,
Mississippi State.) 36 p HC A03/MF A01

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CSCL 05B G3/43 00022

Summary Report

November 1973 - October 1984

NASA Grant NGL 25-001-054

Mississippi Remote Sensing Center

P. O. Drawer FR

Mississippi State, MS 39762

November 1984



Mississippi State University
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INTRODUCTION

The Remote Sensing Applications Program began as a NASA sponsored remote sensing program in 1973 as part of the Institute of Environmental Studies at Mississippi State University. Today the Mississippi Remote Sensing Center (of the Department of Forestry of Mississippi State University and the Mississippi Agricultural and Forestry Experiment Station) administers the Remote Sensing Applications Program. The primary purpose of the Mississippi Remote Sensing Center has been and continues to be participation by the university community in activities that improve effective communication between those engaged in remote sensing research and development and potential users of remote sensing technology. Subsidiary objectives include development of a trained staff from the faculty of Mississippi State University who are capable of addressing varied problem areas identified by state and federal agencies; training of students in various university academic courses at both the undergraduate and graduate levels; dissemination of information and knowledge through workshops, seminars, and short courses; and development of a center of expertise and an operational laboratory for training and assistance to cooperating agencies.

REVIEW OF ACCOMPLISHMENTS

(1 NOVEMBER 1973 - 31 OCTOBER 1984)

General Achievements

- Many remote sensing projects have resulted in useful products or processes or have influenced the activites of users, cooperators or beneficiaries.
- Demonstrations, consultations, and publications have effected technology transfer.

- MRSC's remote sensing research and instruction have been strengthened through expanded staff expertise and acquisition of new data and equipment.
- New remote sensing contracts which can be attributed directly or indirectly to the NASA grant have been obtained with federal and state agencies.
- Announcements of new findings, updated reports of on-going research, and education and training have been dispensed by newsletters, workshops, and orientation sessions.

Applied Research Projects

In accordance with NASA guidelines, each project has been, in some way, unique; essentially noncompetitive with commercial firms; and aimed at producing tangible benefits or actions on the part of the cooperating agency. Relatively little emphasis has been placed on technology transfer, as such. Projects that have met these requirements are listed chronologically with reference to one of the Program's Semi-Annual Status Reports. Tangible benefits to or actions taken by cooperating agencies are marked by *. The report cited by a date in brackets will contain the best description of the project. The projects are numbered and categorized by agency participation and data source in Tables 1 and 2, and their geographic locations are shown in Figures 1 and 2.

1. Bark Beetle Project - Copiah County, Mississippi. A technique was developed with and for use by the Mississippi Forestry Commission (MFC) for recognizing on aerial photographs/images pine stands which have high potential susceptibility to attack by Southern Pine Beetle. MFC uses the technique in its beetle management program* [November 1973].

Table 1. Agency Participation as Cooperator (C) and/or User (U) in Mississippi Remote Sensing Center Projects.

Project Number	Federal	State	County	Town/Local	Private
1		C, U			
2		C, U			
3	U	C, U			U
4	U	U			U
5	C, U				
6	C, U				
7		C, U	U	U	
8		C, U	U	U	C, U
9		C, U			
10		C, U	U	U	
11		C, U	U	U	U
12		C, U			
13		C, U			
14		C, U			
15	U	C, U			
16	C, U				
17		C, U	U		U
18					C, U
19	C, U				
20		C, U			
21	C, U				
22		C, U			
23		C, U			
24	C, U				
25	C, U				C, U
26	U	C, U			
27	C, U	C, U			C, U

Table 2. Remote sensing data employed in Mississippi Remote Sensing Center projects.

Project Number	Aircraft			Satellite
	Low	Medium	High	
1		CIR	CIR	
2		CIR	CIR	
3		CIR		
4		CIR		
5			CIR	
6		CIR		
7		CIR		
8				LD
9				LD
10		CIR		LD
11				LD
12			CIR	LD
13	CIR	CIR		LI, LD
14	CIR			LI, LD
15	CIR			
16		CIR		LD
17				LD
18		CIR		
19				LD
20			CIR	LD
21		P		LD
22*				
23	IS	P		
24		P, CIR		LD, S
25		CIR		
26		CIR		
27	CIR		CIR	

Note: P - panchromatic photographs
 CIR - color infrared
 IS - multispectral scanner
 LD - Landsat digital data
 LI - Landsat imagery
 S - Seasat

*no imagery used.

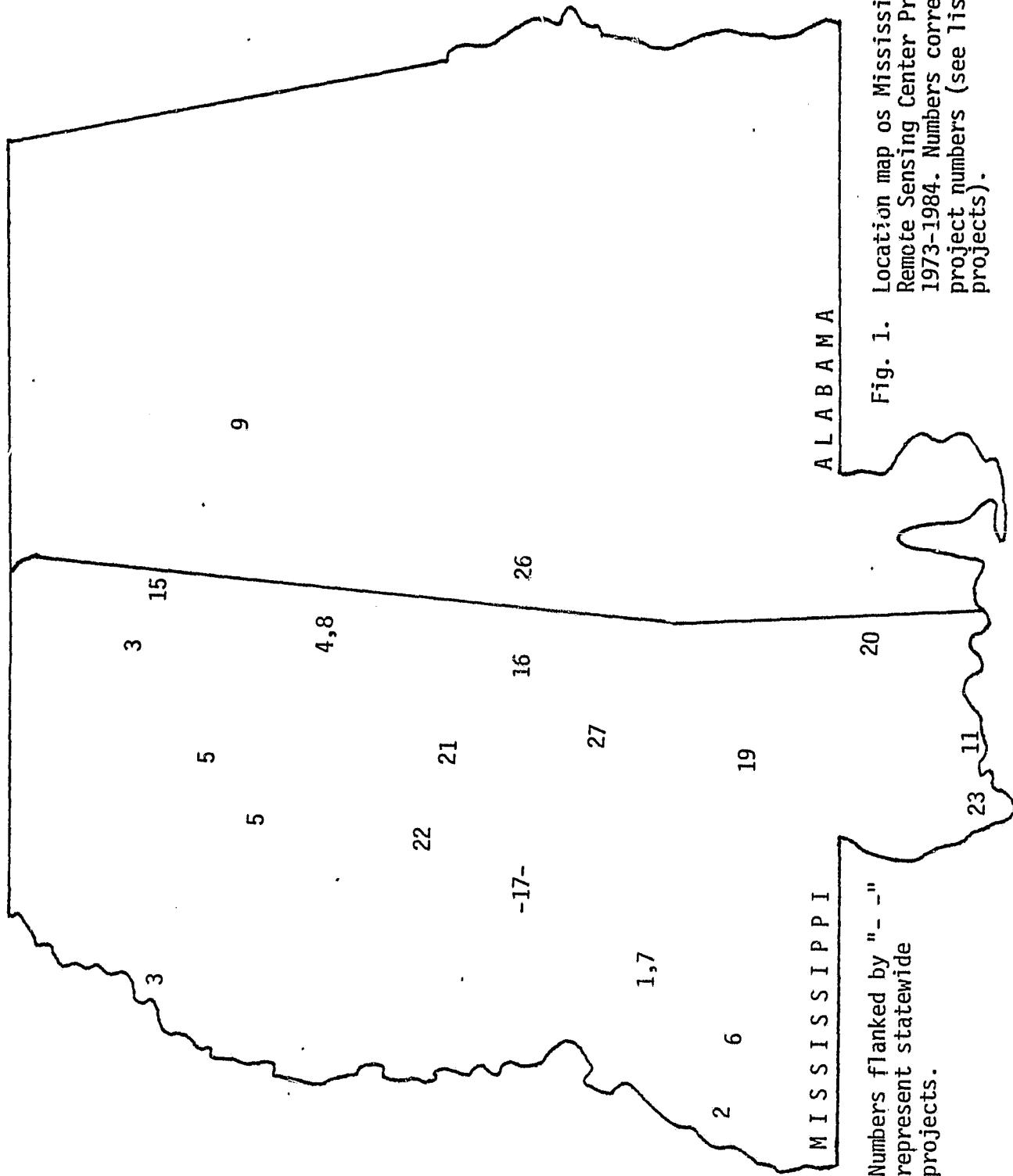
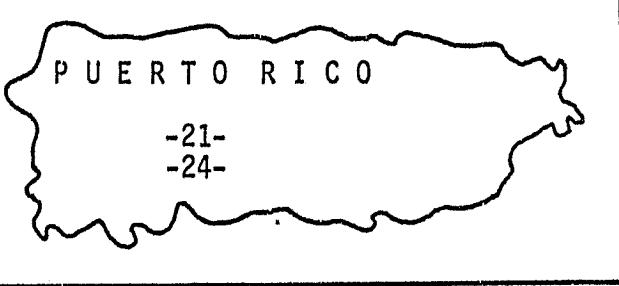


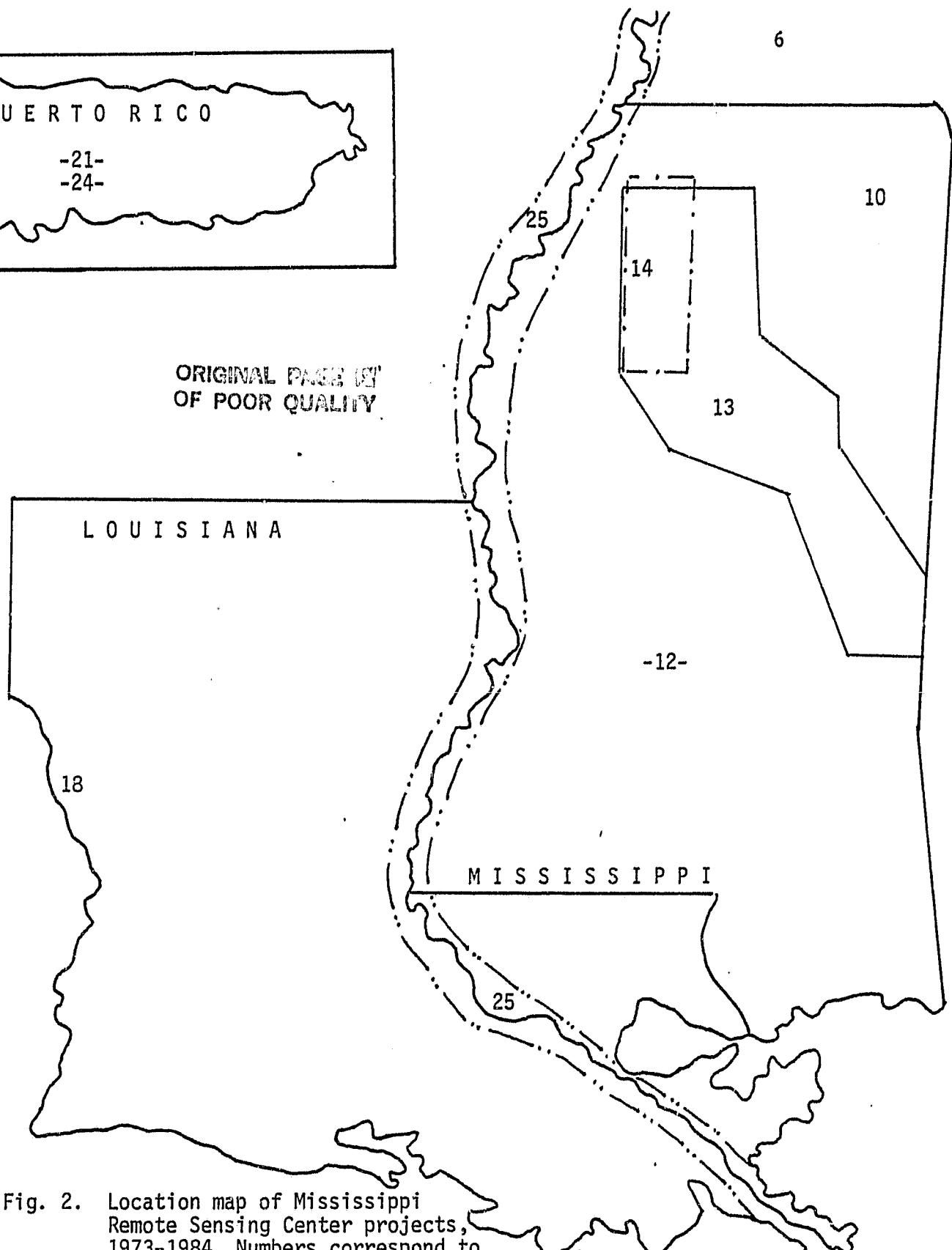
Fig. 1. Location map of Mississippi Remote Sensing Center Projects, 1973-1984. Numbers correspond to project numbers (see list of projects).



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Fig. 2. Location map of Mississippi Remote Sensing Center projects, 1973-1984. Numbers correspond to project numbers (see list of projects). Numbers flanked by " - " represent statewide projects.

2. Location of State Park - Natchez State Park. Using a combination of satellite and aircraft imagery and a modeling technique in a geographic information system, a number of candidate sites for the Natchez State Park were evaluated. The site identified by the MRSC study as most suitable for location of the park was selected by the Mississippi Park Commission for construction of the park* [May 1974].
3. Waste Source Location and Stream Channel Geometry. It was proposed that remote sensing techniques have the possibility of being used in the monitoring of in-stream water quality, to insure that the requirements of the waste allocations are met [November 1973].
4. Water Quality. The objective of this study was to develop an inexpensive means of monitoring water quality; specifically total suspended solids, which would have utility to such agencies as the Mississippi Air and Water Pollution Control Board [May 1975].
5. The Yazoo-Little Tallahatchie (YLT) Flood Prevention Project - Grenada and Calhoun Counties, Mississippi. Guidelines were developed for interpretation of high altitude color infrared imagery to identify tree planting chances. The U.S. Forest Service (State and Private Forestry, YLT) implemented the guidelines in the YLT Flood Prevention Project* [May 1975].
6. A Soil Resource Inventory of a Portion of a National Forest - Homochitto National Forest. This was a demonstrational project of the capability of high-altitude imagery to provide data needed for long-range, unit planning on National Forests. The data would provide information necessary for evaluation of forest and wildlife habitat quality, and recreation planning [November 1974].

7. Forest Resource Inventory of Sixteenth-Section Lands - Copiah County. A procedure is outlined which provides the Mississippi Forestry Commission with an easy but rapid method of updating 16th Section timber inventories [November 1974].
8. Remote Sensing Applications in Land Use Planning - Lowndes County, Mississippi. A Landsat-based data management system was developed by MRSC which provides variables and data that can be used by the County Tax Assessor, Civil Defense Director, Lowndes County Board of Supervisors, and various planning and development organizations. In particular, Lowndes County constructed a fire station to afford fire protection for a part of the County identified using the MRSC geographic information data base as being inadequately protected.* In addition, Lowndes County Civil Defense personnel have issued flash flood alerts to residents of Columbus/ Lowndes County based on data base generated maps of flood prone areas* [May 1976].
9. Application of Landsat Data to Strip Mine Inventory and Reclamation Progress. Software and interpretative techniques were supplied to the Geological Survey of Alabama for monitoring strip mine occurrence and reclamation activities on a periodic basis [May 1976].
10. Remote Sensing Applications for Industrial Siting on the Tennessee-Tombigbee Waterway. MRSC, in conjunction with the Research and Development Center and the Appalachian Regional Commission, (a) inventoried lands within a corridor 10 miles in width centered on the proposed route of the Tennessee-Tombigbee Waterway, (b) identified sites suitable for industrial development, and (c) rated

the sites on the basis of suitability for major types of industrial development [November 1976].

11. Beach Erosion Control Study - Pass Christian, Mississippi. Landsat data was used to identify source areas of wind eroded beach sand, and thereby, the most vulnerable sections of beach. From this information came design and siting of stabilization structures and features such as garden type vegetative communities compatible with beach life and tourist attraction. The Harrison County Board of Supervisors adopted the recommendations of MRSC and installed a number of stabilization structures* [May 1977].
12. Evaluation of White-Tailed Deer Habitat Using Landsat Data. A state-wide data base for the Mississippi Department of Wildlife Conservation was constructed for which vegetative cover types were mapped and from which deer "habitat" (by means of data base modeling) was evaluated* [May 1978].
13. Discrimination of Unique Forest Habitats in Potential Lignite Areas of Mississippi. Methodology was developed for using cost-effective remote sensing techniques to identify large, contiguous areas of old growth hardwoods that do not exhibit signs of recent disturbance and that are found within Mississippi's lignite belt. A map and report of hardwood stands so located was provided to the Mississippi Natural Heritage Program for use in field evaluation of timber stands. The anticipated result would be acquisition/protection of unique hardwood stands from lignite mining [May 1979].
14. Landsat Change Discrimination in Gravel Operations. This study developed methods and computer software to detect changes in gravel

mining along the Loessial Bluffs from a point near Greenwood, Mississippi, to the Mississippi-Tennessee state line using LANDSAT digital data and CIR imagery [May 1979].

15. Environmental Impact Modeling for Highway Corridors. A geographic information system was constructed for a small (8.6 sq. miles) but environmentally sensitive wetlands area to evaluate siting locations for the U.S. Highway 78 bridge across the Tombigbee River. Aircraft imagery was interpreted for land cover identification. The bridge site determined most desirable/least environmentally objectionable by this study was accepted by the Mississippi Highway Department for construction of the bridge* [November 1979].
16. Wetlands Impact Assessment. Pre- and post-construction conditions at Okatibbee Reservoir in Lauderdale County, Mississippi were mapped from current 1:24,000 CIR and historic panchromatic imagery to establish changes in landcover due to impoundment. Results were extended to predict the impact of a proposed impoundment on the Tallahala Creek in Jasper County, Mississippi. The study results were incorporated into an Environmental Impact Statement by the Mobile District Corps of Engineers* [May 1980].
17. A Conceptual Design for a Landsat-Based State-Wide Information System. Software was developed which allows a county to build a geographic information system (GIS) data base of land ownership boundaries, soils, and land cover from which property taxes can be calculated. As originally conceived, all counties would use Landsat data for land cover determinations and each county's data base would be telecommunications linked through the Mississippi

Central Data Processing Authority (CDPA) computer. Although the Landsat updates and CDPA linkages have not been implemented, a number of Mississippi counties handle tax mapping and assessment through county GIS data bases* [May 1981].

18. Hodges Gardens Site Development Study. In response to a geographic information system (GIS) demonstration, a landscape architecture undergraduate at Mississippi State University chose to build a GIS data base for Hodges Gardens, a privately owned botanical garden near Many, Louisiana. The resulting plan is being implemented at Hodges Gardens* [November 1981].

19. Pipeline Corridor Evaluation. Using Landsat data in a geographic information system, alternative natural gas pipeline routes across portions of Forrest and Jones Counties, Mississippi, were evaluated. The evaluations were requested by the Federal Energy Regulatory Commission (FERC) for use in evaluating a request for a right-of-way permit from a gas-pipeline company. MRSC's classification/evaluation of the proposed right-of-way was so similar to the gas-pipeline companies that FERC suppressed the report saying it weakened the FERC Case* [November 1981].

20. Development of a GIS for Discrimination of Gopher Tortoise Colony Sites. At the request of the Mississippi Natural Heritage Program a data base of George County, Mississippi, was constructed in and from which gopher tortoise habitat was modeled based on conditions at known gopher tortoise colony sites. Maps of potential tortoise habitat were supplied to Natural Heritage for field examination [May 1982].

21. Resource Evaluation Techniques for Mountainous Tropical Forests: Landsat Capabilities. In a joint effort with the U. S. Forest Service (USFS), Southern Forest Experiment Station, MRSC has completed a methodological study with the objective of developing techniques, based on remotely sensed data for rapid, efficient resource surveys in tropical regions. The primary effort was to investigate the feasibility of merging standard USFS forest survey data with large area, tropical land cover classification derived from satellite (Landsat MSS) data [May 1982].
22. Evaluating Thornthwaite's Water Balance Method for Evapotranspiration. Thornthwaite's Water Balance technique of hydroclimatological assessment for small area (watershed) studies was studied. Runoff estimation accuracy was evaluated for possible inclusion as a GIS data base variable [November 1983].
23. Remote Sensing and the Mean High Tide Line. A cooperative venture of the Mississippi Forestry Commission, the Mississippi Secretary of State, and MRSC sought to develop a technique and to map the extent of mean high tide in Mississippi Coastal Waters [November 1983].
24. SAR Enhancement of Landsat-3 Digital Data for Tropical Forest Habitat Inventory. This study seeks to determine if forest type discrimination in Puerto Rico can be improved by merging Seasat radar (SAR) data with Landsat (MSS) data [May 1984].
25. Land Cover Mapping for the Mississippi River Data Base. MRSC, as a subcontractor to Gulf South Research Institute of Baton Rouge, Louisiana, is producing land cover maps of the area between the

Mississippi River from Cairo, Illinois, to Head of Passes, Louisiana, for the Corps of Engineers. Mapping is being performed on color infrared (CIR) imagery, supplemental high altitude CIR imagery for those portions of the River covered by National High Altitude Program (NHAP), and panchromatic imagery [May 1984].

26. Development of a Geographic Information System (GIS) for Determination of Seasonal Habitat Preferences of Coyotes. In cooperation with the Mississippi Cooperative Fish and Wildlife Research Unit, MRSC is preparing a GIS data base of 16,000 hectares in Sumter County, Alabama to study food habits, home range, and interspecific interactions of coyotes and grey and red foxes. Land cover is determined by inspection/interpretation of NHAP imagery, and TELEPRO software will be used to process animal location data for inclusion into the GIS data base [May 1984].
27. Development of a Geographic Information System (GIS) for Determination of Seasonal Habitat Preferences of Wild Turkeys. As a part of a study of the Mississippi Cooperative Wild Turkey Project, MRSC is constructing a GIS data base for a portion of the Tallahala Wildlife Management Area in Jasper County, Mississippi. Detailed land cover data is being interpreted from color infrared images taken with an I²S sensor from Mississippi Forestry Commission aircraft. Radio telemetry data will be processed by TELEPRO software for inclusion in the data base [May 1984].

A list of publications which are the direct result of projects or related findings which led to publications are included in Appendix A.

Communication and Instruction

Curriculum and Students -- The Program staff has upgraded Mississippi State's curriculum in aerial photographic studies and remote sensing. A course in aerial photography and/or remote sensing was taught at various times during the 1970's by the Departments of Civil Engineering and Geography-Geology. However, forest photogrammetry has been offered in the Department of Forestry since 1956. The course Remote Sensing Applications in Resource Management was developed and offered for the first time in 1976, and the course Introduction to Remote Sensing taught by the Department of Geography was created as a result of the Remote Sensing Applications Program. These courses are described in Appendix B. The typical enrollment in these courses is:

<u>Courses</u>	<u>Number of Students Each Semester</u>	
	<u>Fall</u>	<u>Spring</u>
Forest Photogrammetry	45	*
Remote Sensing Applications	*	10
Introduction to Remote Sensing	22	*

*Not Offered.

In addition to these courses in remote sensing, students may perform independent study and research through special courses, professional master's design projects, or through M.S. theses (Appendix C).

Newsletter -- The newsletter "SCANLINES" is a quarterly publication aimed at promotion of the activities of MRSC and at publicizing products, techniques, and findings of the laboratory. "SCANLINES" is currently received by 283 individuals and groups in 35 states and 11 countries.

Contacts -- Graduate students and members of the Center's staff have participated in studies with individuals, groups and agencies, and the Center has provided information and educational materials to vast numbers of visitors to the University. In Appendix D are listed contacts with visitor and user groups categorized according to whether their representatives: (1) cooperated in one or more projects, (2) were users of the results of a project in which they may or may not have participated, or (3) were involved in either preliminary discussions or discussions which have not as yet led to a specific project or who contacted the lab for publications, information or assistance (of less than formal-project nature). Included in Appendix D are those projects whose agency participation was outlined in Table 1.

Data and Facilities

MRSC has developed interpretation capabilities with a wide range of aircraft and satellite-derived data. With NASA assistance, MRSC has obtained Landsat MSS, TM, and Seasat CCT's; NCIC digital terrain tapes; and high, medium, and low altitude aircraft photographic and scanner coverage of Mississippi and portions of Alabama, Louisiana and Puerto Rico. In addition to NASA assistance in data collection, imagery has been purchased for specific studies or donated to MRSC by Mobile and Nashville Districts (Corps of Engineers), Mississippi Natural Heritage Program, U.S. Forest Service (USDA), Agriculture Stabilization and Conservation Service (USDA), Marshall Space Flight Center, U.S. Fish and Wildlife Service, School of Forest Resources (Mississippi State University), Mississippi Secretary of State, Geological Survey of Alabama, and the Mississippi Department of Wildlife Conservation.

Over the life of the program equipment has been acquired to process, view and use remotely sensed data. This equipment includes: (1) Data General S/130 minicomputer; (2) Lexidata image processing microprocessor with color additive monitor; (3) Numonics electronic graphic calculator; (4) Texas Instruments Silent 700 electronic data terminal and associated telephone modem; (5) Variscan; (6) I²S aerial camera and multispectral viewer; (7) Zoom Transfer Scope; (8) Magnetometer; (9) portable television monitor; (10) color analyzer; (11) Varian printer-plotter; and (12) multispectral viewer. These instruments supplement the standard image analysis equipment obtained with non-NASA funds (i.e., MATRIX camera, Bausch and Lomb zoom 240 stereoscope and Richards light table, lens and mirror stereoscopes, Kelsh stereo-plotter, and other equipment).

Program Staff

Since November 1973, the MRSC staff has included thirteen professors (part-time on the program), five research associates, seven graduate students/research associates, ten graduate students, and two undergraduate students.

APPENDIX A

Recent publications and/or presentations which resulted directly or indirectly from investigations at MRSC.

1. TELEPRO: Modeling Seasonal Habitat Preferences of White-tailed Deer. W. Frank Miller and Karen M. Herrington. A poster presentation at Wildlife 2000: Modeling Habitat Relationships of Terrestrial Vertebrates. A Symposium at Stanford Sierra Camp, Fallen Leaf Lake, California. 7-11 October 1984.
2. Birdsey, R. A., Miller, W. F., Clarke, J., and Smith. R. H. 1984. Forest Area Estimates from Landsat MSS and Forest Inventory Plot Data. U. S. Dept. Agric. Research Paper SO-211, Southern For. Exp. Stn., New Orleans, La. 7 p.
3. Modeling Runoff in Central Mississippi: An Evaluation of the Water Balance Method. John Tingle. A paper presented to Mississippi Academy of Sciences, Inc., Biloxi, MS, 23-24 February 1984.
4. Miller, W. F. 1983. Alternative Futures for Resource Management, In Water - A Resource in Demand. Proceedings of a Symposium on Future Climate and Potential Impacts on Natural Resource Management. ed. by W. Frank Miller. Southern Cooperative Series Bulletin 288, The Southern Forest Environment Research Council of the Association of Southern Region Agricultural Experiment Station Directors and The Cooperative State Research Service. Texas A & M University, College Station, TX, 16-18 August 1982.
5. Discrimination of Active Gravel Operations Using Landsat MSS Data. Final Technical Report No. 82-1 by D. P. Turnipseed and W. F. Miller submitted to the Mississippi Mineral Resources Institute. April 1982. 72 p.
6. Birdsey, R. A. and Weaver, P. L. 1982. The Forest Resources of Puerto Rico. U. S. Dept. of Agric. Resource Bulletin SO-85. Southern For. Exp. Stn., New Orleans, LA. 59 p.
7. Remote Sensing Applications in Wildlife Telemetry-Habitat Studies. A report to Mississippi Cooperative Fish and Wildlife Research Unit and the U. S. Fish and Wildlife Services in fulfillment of contract No. 14-16-0009-80-056 submitted by Frank Miller, Robert Smith and Linda Wright. 18 February 1982. 45 p.
8. Miller, W. F. 1981. Remote Sensing Techniques in Historical Site Discrimination. Remote Sensing of Environment 11:463-471.
9. Wetlands Impact Assessment for the Proposed Tallahala Creek Lake, Jasper County, Mississippi. A report submitted to Mobile District, U. S. Army Corps of Engineers by W. Frank Miller and Linda H. Wright in fulfillment of Contract No. DACW01-80-C-0296. September 1981. 97 p.

10. Miller, W. F. and Carter, B. D. 1979. Rational Land Use Decision Making: The Natchez State Park. Remote Sensing of Environment 8:25-38.
11. Remote Sensing Applications and Archeological Investigations: Sharpley's Bottom, Vinton, Barton and Colbert, Mississippi. A report submitted to Interagency Archeological Services by W. Frank Miller, (funds supplied by Mobile Office, Corps of Engineers) in fulfillment of Contract No. C5968-(79). 29 June 1979. 82 p.
12. Environmental Impact Modeling for Highway Corridors. A report to Mississippi Highway Department by W. Frank Miller, Mississippi Remote Sensing Center, Miss. State, MS. 17 p.

APPENDIX B

Course Offerings in Aerial Photography and Remote Sensing of the Department of Forestry, Mississippi State University, 1983-1984.

FO 4543/6543 FOREST PHOTOGAMMTRY. Two lectures. Three hours laboratory. Fundamentals of scale, area, height, and stand volume determinations from aerial imagery; planimetric and topographic mapping; basic image interpretation; application to natural resource inventory.

FO 5543/7543 REMOTE SENSING APPLICATIONS IN RESOURCE MANAGEMENT. Two lectures. Three hours laboratory. An introduction to remote sensing with primary emphasis on interpretation and applications of remotely sensed data in inventory, monitoring, and management of renewable natural resources.

Course offerings in Remote Sensing of the Department of Geography, Mississippi State University, 1983-1984.

GR 2713. INTRODUCTION TO REMOTE SENSING. Three lectures. Fundamental principles of remote sensing, including types and applications. Attention is given to feature identification, to planning and problem solving, and to policy formulation.

GR 2711. REMOTE SENSING LABORATORY. Two hours laboratory. Practical problem application of remotely sensed imagery, utilizing scanner, optical, and image processing equipment. Designed to accompany GR 2713.

APPENDIX C

Theses and Professional Papers of Graduate Students Whose Research Included Remote Sensing or Geographic Information Systems as Major Considerations. Mississippi State University, November 1973 - October 1984.

Aerial Photographs As A Tool For Game Habitat Evaluation. Sonia Eloise Hathaway de Lima. May 1974.

The Delineation of Forest Habitat with Remotely Sensed Data. Timothy R. Cannon. December 1974. (Professional Paper).

Remote Sensing Applications In Water Quality Surveillance. Donald Wayne Finnie. December 1975.

Development of a Risk Rating System for Southern Pine Beetle Infestations In Copiah County, Mississippi. Steven A. Sader. May 1976.

A Comparison of Methodologies and Data Products Commonly Used To Analyze Forest Land Cover. Robert C. Maggio. May 1977.

A Microcomputer Based Image Processing Operating System. Steven Alan Von Edwins. August 1978.

General Image Manipulation Functions in a Geographic Information System. David Gene Scott. May 1980.

Local Image Properties Effecting Data Storage Structure Selection in a Geographic Information. Rena Haynes. August 1980.

An Information Theoric Spatial Transform for Digital, Multispectral Satellite Imagery. John Powers. December 1980.

The Detection and Mapping of Land Cover Types Significant to White-Tailed Deer Management In Mississippi Using Landsat Multispectral Scanner Data. Jonathan R. Clark. December 1980.

Movements and Habitat Use by White-Tailed Deer In A Bottomland Hardwood Area of Mississippi. Seth Evans Mott. August 1981.

Taxcal: A Polygonal Database System for Tax Calculation on Land Parcels. Karen Minchew. May 1982. (Professional Paper).

Classification of Land Cover and Land Utilization Potential in Central Rift Valley Province of Kenya. Pius Walubengo Mumiukha. December 1982.

TMPGENN: A Data Transformation and Analysis Method For Landsat Multispectral Scanner Data. Linda Raycelia Hale Wright. August 1984.

APPENDIX D

Project-related contacts of Mississippi Remote Sensing Center (November 1973 - October 1984); Cooperator = 1; User = 2; Other = 3.

Federal:

Cooperative Extension Service, Washington, DC	3
Environmental Protection Agency, Warrenton, VA	2, 3
Federal Aviation Administration, Atlanta, GA	2, 3
Federal Energy Regulatory Commission, Washington, DC	1, 2
NASA/ERL, NSTL Station, MS	1, 2, 3
NASA, L. B. Johnson Space Center, Houston, TX	1, 2, 3
NOAA, Environmental Data Section, Dauphin Island, AL	3
NOAA, National Weather Service, Jackson, MS	3
NOAA, National Weather Service, Southeastern River Forecast Center, Atlanta, GA	3
Tennessee Valley Authority, Norris, TN	3
U.S. Air Force, Columbus Air Force Base, Columbus, MS	3
U.S. Army Corps of Engineers:	
Mobile, Alabama	1, 2, 3
Steve Reed, Vicksburg, MS	2, 3
Waterways Experiment Station, Vicksburg, MS	2, 3
U.S. Coast and Geodetic Survey, Washington, DC	3
USDI Bureau of Indian Affairs	3
U.S. Fish and Wildlife Service:	
Bruce Johnson, Decatur, AL	2, 3
White River Refuge, AR	3
Jackson, MS	2, 3
Newton Corner, MA	3
Vicksburg, MS	3
Raleigh, NC	3

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Federal: (continued)

U.S. Forest Service:

National Forests in Arkansas, Hot Springs, AR	3
State and Private Forestry, Atlanta, GA	2, 3
State and Private Forestry, Yazoo-Little Tallahatchie Flood Control Project, Oxford, MS	1, 2, 3
Pineville, LA	3
Southern Forest Experiment Station, New Orleans, LA	2, 3
Ackerman, MS	3
Jackson, MS	1, 2, 3
Rolling Fork, MS	2, 3
Tree Seed Laboratory, Starkville, MS	3

U.S. Geologic Survey, Jackson, MS

3

U.S. Senator John Stennis, Dekalb, MS

3

U.S. Soil Conservation Service:

Joe Sigrest, New Orleans, LA	3
Digital Mapping Branch, Rockville, MD	3
Amory, MS	3
Jackson, MS	1, 2, 3

State:

Agricultural Experiment Station, University of Alaska,
Fairbanks, AK

3

University of California, Dept. of Engineering, Davis, CA

3

National Conference of State Governors, Denver, CO

3

Southern Community State College, New Haven, CT

3

University of Florida, Dept. of Archeology, Gainesville, FL

3

Georgia Tech University, Remote Sensing Lab, Atlanta, GA

3

University of Idaho, Dept. of Forestry, Moscow, ID

3

Wildlife Research Station, Boone, IA

3

University of Kansas, KARS Program, Lawrence, KS

3

Wichita State Univ., Biological Sciences Dept., Wichita, KS

3

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State: (continued)

E. Kentucky Univ., Div. of Natural Resources, Richmond, KY	3
University of Maryland, Gilbert Commonwealth, College Park, MD	3
Univ. of Mass., Dept. of Landscape Architecture, Amherst, MA	3
Columbia Training School, Columbia, MS	3
Itawamba Junior College, Forestry Institute, Fulton, MS	2, 3
Northeast Mississippi Junior College, Booneville, MS	3
Mississippi:	
Adjutant General's Office, Jackson	3
Central Data Processing Authority, Jackson	2, 3
Civil Defense Council, Jackson	3
Cooperative Extension Service:	
Starkville, MS	2, 3
Data Processing Group, Starkville, MS	3
Food and Fiber Group, Starkville, MS	3
Cooperative Fish and Wildlife Service Research Unit, Starkville, MS	1, 2, 3
Department of Archives and History, Jackson	3
Department of Natural Resources, Jackson	2, 3
Employment Service:	
Columbus	3
Starkville	3
Forestry Commission, Jackson	1, 2, 3
Governor's Office of Space and Technology, Jackson	3
Governor's School for Gifted Children, Columbus	3
Highway Department:	
Jackson	1, 2, 3*
Tupelo	2, 3
Mineral Resources Institute, Oxford	1, 2, 3
Natural Heritage Program, Jackson	1, 2, 3
Research and Development Center, Jackson	1, 2, 3
State Representative and Senators:	
Dale Ford, Jackson	3
Bruce Hansen, Columbus	3
Mark McInnis, Jackson	3
John Nipper, Jackson	3
Perrin Purvis, Tupelo	3
William Wilkerson, Jackson	3
State Tax Commission	3

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Mississippi State University Departments:	
Agriculture and Home Economics	3
Agricultural and Biological Engineering	2, 3
Agricultural Economics	3
Agronomy	1, 2, 3
Anthropology	2, 3
Archeology	1, 2, 3
Architecture	2, 3
Biological Science	2, 3
Civil Engineering	1, 2, 3
Continuing Education	3
Entomology	1, 2, 3
Forestry	1, 2, 3
Geology and Geography	1, 2, 3
Landscape Architecture	2, 3
Plant Pathology and Weed Science	3
Political Science	2, 3
Wildlife and Fisheries	1, 2, 3
Zoology	2, 3
Montana State Univ., Dept. of Computer Sciences, Bozeman, MT	3
Univ. of Nebraska, Remote Sensing Laboratory, Omaha, NB	3
Oklahoma State Univ., Dept. of Forestry, Stillwater, OK	3
Clemson Univ., Dept. of Forestry, Clemson, SC	3
University of Tennessee, Knoxville, TN:	
Tim Young	2, 3
Department of Botany	3
Texas A & M Univ., Dept. of Forestry, College Station, TX	3
Virginia Institute of Marine Science, Gloucester Point, VA	3
Virginia Tech. and State Univ., Dept. of Agricultural Engineering, Petersburg, VA	3

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County/Regional:

Mississippi:

Jackson County Civil Defense Director, Pascagoula	3
Lee County, Tupelo:	
Board of Supervisors	3
Chancery Clerk	3
Lowndes County, Columbus:	
Board of Supervisors	3
Civil Defense Director	1, 2, 3
Data Processing Manager	2, 3
Madison County, Canton:	
Chancery Clerk	2, 3
Tax Assessor	3
Oktibbeha County Tax Assessor, Starkville	3
Tallahatchie County Tax Assessors, Charleston	3

Local/Private:

Royal Abraham, Clarksdale, MS	3
Agricultural Bankers (Mid-South Region)	3
Anderson-Clayton, Texas	3
Andrews University, Michigan	3
R. P. and M. Anjard, Indiana	3
Ashland Coal, Inc., Kentucky	3
Associated Planning Group, Inc., Canton, MS	3
Bank of Mississippi, Tupelo, MS	3
Bennett and Peters, Inc., LA	3
Blue Mountain College, Blue Mountain, MS	2, 3
Boise Southern Company, LA	3
Brice, Petrides and Assoc., Inc., Iowa	3
Caledonia High School, Caledonia, MS	3

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Local/Private: (continued)

Chamber of Commerce:

Columbus, MS	3
Starkville, MS	3

Champion Timberlands:

Russellville, AR	3
Stanford, CT	3

Colbert Real Estate:

Columbus, MS	3
Starkville, MS	3

Colonial Hunting Club, MS

3

Commercial Dispatch, Columbus, MS

3

Community Development Foundation, Tupelo, MS

3

Charles Craig, Friars Point, MS

2, 3

Crewley's Ridge Aerial Service, Wynn, AR

2, 3

Cumberland High School, Cumberland, MS

3

Dayton-Dalton-Newport, Cleveland, OH

3

Deere and Company, Moline, IL

3

Dvorkovity and Assoc., Ormand Beach, FL

3

E, G and G, Environmental Consultants, Waltham, MA

3

Eastern Energy and Land Use Team, Kearneyville, WV

3

Dr. J. I. Ebert, Albuquerque, NM

3

Entomological Services, Oxford, MS

3

First Citizens National Bank, Columbus, MS

3

First Columbus National Bank, Columbus, MS

3

George County Farm Center, Lucedale, MS

3

Golden Triangle Planning & Development District, Starkville, MS

3

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Local/Private: (continued)

Gulf Research and Development Company, Lakewood, CO	3
Gulf State Paper Company:	
Coher, AL	3
Tuscaloosa, AL	3
Hale Agricultural Services, Pontotoc, MS	3
L. D. Handcock and Company, Tupelo, MS	3
Harlan Bartholomew and Associates, Atlanta, GA	3
Herndon Well and Supply, Shannon, MS	3
International Paper Company:	
Natchez, MS	3
Winsboro, SC	3
Lockheed Engineering and Management Services, NSTL Station, MS	3
Loyola University, Chicago, IL	3
Magnolia High School, Magnolia, MS	3
Mayor, Tupelo, MS	3
Bill McClure, Columbus, MS	3
Mississippi Farm Bureau Federation, Jackson, MS	3
Mississippi Farmers Cooperative:	
Jackson, MS	3
Madison, MS	3
Starkville, MS	3
Mississippi Forestry Association, Jackson, MS	3
Molpus Lumber Company, Philadelphia, MS	3
National Bank of Commerce:	
Columbus, MS	3
Starkville, MS	3
Nature Conservancy:	
Chapel Hill, NC	3
Washington, DC	3

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Local/Private: (continued)

Northeast Mississippi Production Credit Association, Tupelo, MS	3
North Mississippi Medical Center, Tupelo, MS	3
Oak Ridge National Laboratory, Oak Ridge, TN	3
Robert Parker, Starkville, MS	3
George Parsons, Architect, Starkville, MS	3
People's Bank and Trust Company, Tupelo, MS	3
Piedmont Planning District Commission, Farmville, VA	3
Potlatch Corporation, Warren, AR	3
Princeton Aqua Services, New Brunswick, NJ	3
Public Technology, Inc., Washington, DC	3
David Rankin, Sumner, MS	2, 3
Reagan and Smith Engineers, Nashville, TN	3
Reaves and Sweeney Engineers, Memphis, TN	2, 3
Frank Riley, Tupelo, MS	3
Rotary Club, Starkville, MS	3
Kirk Rutledge, Nettleton, MS	3
Seminole Manufacturing, Columbus, MS	3
Mark Shultz, Albany, CA	3
Solar Energy Research Institute, Golden, CO	3
Stanley Consultants, Muscatine, IA	2, 3
Sturgis Lumber Company, Sturgis, MS	2, 3
Sunshine Grain Company, Tupelo, MS	3
Swoop Real Estate:	
Columbus, MS	3
Starkville, MS	3

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Local/Private: (continued)

Tensor Industries, Falls Church, VA	3
Three Rivers Educational Cooperative, New Albany, MS	3
TRW, Inc., Redondo Beach, CA	3
Tupelo Separate School District, Tupelo, MS	3
Union Camp Corporation:	
Columbus, MS	3
Sarcumah, GA	3
Weyerhaeuser Corporation:	
Centralia, WA	3
Columbus, MS	2, 3
Dierks, AR	3
New Bern, NC	3
John White, Urbana, IL	3

International:

Australia:	
Division of Land Resources Management, CSIRO	3
Belgium:	
Mr. ir E. Maes, Belfotop	3
P. Bremt, Gent	3
Brazil:	
Federal University of Pelotas	3
Canada:	
Alberta Remote Sensing Center	3
Canada Center for Remote Sensing, Ottawa	3
Carole Girard, Chelmsford	3
J. B. Musgrove, Edmonton	3
Saskmont Engineering, Saskatoon	3
England:	
Geo. Abstracts, Ltd., U. of East Anglica	3
Montoring & Assessment Research Center, London	3

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International: (continued)

Ecuador:

Centro de Levantamientos Integrados de Recursos Naturales
por Sensores Remotes, Quito 3

France:

Laboratoire de Ecologie de la Pinede Landaise 3

Holland:

Prof. Verhoven 3

Hungary:

Pecs Designing Company, Pecs 3

India:

Department of Soils, Punjab Agricultural Univ. 3

Baldev Sahai, Space Applications Centre, ISRO,
Jodhpur, Tebra 3

Israel:

Institute for Desert Research, Ben-Gurion Univ. 3

Kenya:

Ministry of Agriculture 2, 3
Egerton College 2, 3

Mexico:

Commission del Pal Nacional Hidraolico, Mexico City 3
Instituto Nacional de Investigaciones Forestales, 3
Centro de Formacion, Secretaria de Agriculture
U.N. Environmental Program, Mexico City 3
W. S. Warnhalts, Mexico City 2, 3

Poland:

M. Pieruth, Legnica 3

South Africa:

Land Use Division, Natal Provisional Administration, 3
Natalia
Saaveld Forest Research Station, George 3

Spain:

Nucleo Univ. de Pedralbes, Dept. of Edaphology 3
University of Madrid, Dept. of Botany 3

West Germany:

Geography, Dr. Dodt, Ruhr-Universitat Bochum 3
Laboratory of Field Archeology, Bonn 3
